L Number	Hits	Search Text	DB	Time stamp
1	3885	(supplementary spare auxiliary secondary) adj2 area	USPAT; US-PGPUB; EPO; JPO	2004/03/05 13:50
2	25	((supplementary spare auxiliary secondary) adj2 area) same (start adj2 address$3)	USPAT; US-PGPUB; EPO; JPO	2004/03/05 13:49
3	48	(primary main) adj2 spare adj area	USPAT; US-PGPUB; EPO; JPO	2004/03/05 13:41
4	48	((supplementary spare auxiliary secondary) adj2 area) and ((primary main) adj2 spare adj area)	USPAT; US-PGPUB; EPO; JPO	2004/03/05 13:42
6	48	((supplementary spare auxiliary secondary) adj2 area) same ((primary main) adj2 spare adj area)	USPAT; US-PGPUB; EPO; JPO	2004/03/05 13:48
7	207	((supplementary spare auxiliary secondary) adj2 area) and ((start adj2 address$3) same (start adj2 address$3))	USPAT; US-PGPUB; EPO; JPO	2004/03/05 13:50
8	51	(supplementary spare auxiliary secondary) adj spare adj area	USPAT; US-PGPUB; EPO; JPO	2004/03/05 13:50
9	3	((supplementary spare auxiliary secondary) adj spare adj area) and ((start adj2 address$3) same (start adj2 address$3))	USPAT; US-PGPUB; EPO; JPO	2004/03/05 13:50

L Number	Hits	Search Text	DB	Time stamp
1	3885	(supplementary spare auxiliary secondary) adj2 area	USPAT; US-PGPUB; EPO; JPO	2004/03/05 13:40
2	25	((supplementary spare auxiliary secondary) adj2 area) same (start adj2 address$3)	USPAT; US-PGPUB; EPO; JPO	2004/03/05 13:34
3	48	(primary main) adj2 spare adj area	USPAT; US-PGPUB; EPO; JPO	2004/03/05 13:41
4	48	((supplementary spare auxiliary secondary) adj2 area) and ((primary main) adj2 spare adj area)	USPAT; US-PGPUB; EPO; JPO	2004/03/05 13:42
6	48	((supplementary spare auxiliary secondary) adj2 area) same ((primary main) adj2 spare adj area)	USPAT; US-PGPUB; EPO; JPO	2004/03/05 13:42

L Number	Hits	Search Text	DB	Time stamp
1	1	6469978.pn.	USPAT; US-PGPUB; EPO; JPO	2004/03/05 10:42
2	136095	address$4 same (start end begin$4)	USPAT; US-PGPUB; EPO; JPO	2004/03/05 10:43
3	1	6469978.pn. and (address$4 same (start end begin$4))	USPAT; US-PGPUB; EPO; JPO	2004/03/05 10:53
4	40	(transfer$4 exchang$4 allocat$4) same PDL same SDL	USPAT; US-PGPUB; EPO; JPO	2004/03/05 10:54
5	33007	certif$7	USPAT; US-PGPUB; EPO; JPO	2004/03/05 10:55
6	30	((transfer$4 exchang$4 allocat$4) same PDL same SDL) and certif$7	USPAT; US-PGPUB; EPO; JPO	2004/03/05 10:55
7	2	((transfer$4 exchang$4 allocat$4) same PDL same SDL) same certif$7	USPAT; US-PGPUB; EPO; JPO	2004/03/05 11:01
8	28	(((transfer$4 exchang$4 allocat$4) same PDL same SDL) and certif$7) not (((transfer$4 exchang$4 allocat$4) same PDL same SDL) same certif$7)	USPAT; US-PGPUB; EPO; JPO	2004/03/05 11:02

L Number	Hits	Search Text	DB	Time stamp
1	2886184	(spare supplementary auxiliary substitut$3) 4a (((record$4 writ$4) adj2 (area location)) memory storage)	USPAT; US-PGPUB; EPO; JPO	2004/03/03 11:12
2	138409	((spare supplementary auxiliary substitut$3) 4a (((record$4 writ$4) adj2 (area location)) memory storage)) same (allocat$4 deallocat$4 assign$4)	USPAT; US-PGPUB; EPO; JPO	2004/03/03 11:15
3	3220848	((spare supplementary auxiliary substitut$3) 4a (((record$4 writ$4) adj2 (area location)) memory storage)) 8a (allocat$4 deallocat$4 assign$4)	USPAT; US-PGPUB; EPO; JPO	2004/03/03 11:17
6	1451	defect$3 near4 management	USPAT; US-PGPUB; EPO; JPO	2004/03/03 11:18
7	212	(((spare supplementary auxiliary substitut$3) 4a (((record$4 writ$4) adj2 (area location)) memory storage)) same (allocat$4 deallocat$4 assign$4)) same (defect$3 near4 management)	USPAT; US-PGPUB; EPO; JPO	2004/03/03 11:18
8	168455	369.clas. 360.clas.	USPAT; US-PGPUB; EPO; JPO	2004/03/03 11:19
9	113	((((spare supplementary auxiliary substitut$3) 4a (((record$4 writ$4) adj2 (area location)) memory storage)) same (allocat$4 deallocat$4 assign$4)) same (defect$3 near4 management)) and (369.clas. 360.clas.)	USPAT; US-PGPUB; EPO; JPO	2004/03/03 11:19
10	4	((((spare supplementary auxiliary substitut$3) 4a (((record$4 writ$4) adj2 (area location)) memory storage)) same (allocat$4 deallocat$4 assign$4)) same (defect$3 near4 management)) same variable	USPAT; US-PGPUB; EPO; JPO	2004/03/03 11:20
11	113	(((((spare supplementary auxiliary substitut$3) 4a (((record$4 writ$4) adj2 (area location)) memory storage)) same (allocat$4 deallocat$4 assign$4)) same (defect$3 near4 management)) and (369.clas. 360.clas.))	USPAT; US-PGPUB; EPO; JPO	2004/03/03 11:43
12	4317	(Primary adj defect adj list) PDL	USPAT; US-PGPUB; EPO; JPO	2004/03/03 11:44
13	2114	(secondary adj defect adj list) SDL	USPAT; US-PGPUB; EPO; JPO	2004/03/03 11:44
14	242	((Primary adj defect adj list) PDL) and ((secondary adj defect adj list) SDL)	USPAT; US-PGPUB; EPO; JPO	2004/03/03 11:45
15	107	(((Primary adj defect adj list) PDL) and ((secondary adj defect adj list) SDL)) and ((((spare supplementary auxiliary substitut$3) 4a (((record$4 writ$4) adj2 (area location)) memory storage)) same (allocat$4 deallocat$4 assign$4)) same (defect$3 near4 management))	USPAT; US-PGPUB; EPO; JPO	2004/03/03 11:45
16	72	((((Primary adj defect adj list) PDL) and ((secondary adj defect adj list) SDL)) and ((((spare supplementary auxiliary substitut$3) 4a (((record$4 writ$4) adj2 (area location)) memory storage)) same (allocat$4 deallocat$4 assign$4)) same (defect$3 near4 management))) and (369.clas. 360.clas.)	USPAT; US-PGPUB; EPO; JPO	2004/03/03 11:45

L Number	Hits	Search Text	DB	Time stamp
1	469	(spare near3 area) same ((user data) near2 area)	USPAT; US-PGPUB; EPO; JPO	2004/03/03 14:37
2	95	((spare near3 area) same ((user data) near2 area)) same format$5	USPAT; US-PGPUB; EPO; JPO	2004/03/03 14:37
3	23	assign$4 same (((spare near3 area) same ((user data) near2 area)) same format$5)	USPAT; US-PGPUB; EPO; JPO	2004/03/03 14:38

US-PAT-NO: 6631106

DOCUMENT-IDENTIFIER: US 6631106 B1

TITLE: Spare area with a predetermined capacity for a detective sector allocated in each zone

R1

Drawing Description Text - DRTX (12):

FIGS. 11A to 11C are explanatory diagrams of a slipping process using a primary defect list PDL at the time of formatting by a defect processing unit in FIG. 10 and an alternating process using a secondary defect list SDL after completion of the formatting;

Detailed Description Text - DETX (5):

FIG. 4 is an explanatory diagram of a disk layout of the optical disk 36 of 1.3 GB built in the optical disk cartridge 10 in FIG. 2. The disk layout is shown by the logical track number of the optical disk 36, one logical track is constructed by 17 sectors, and one sector is constructed by 2048 bytes. The optical disk 36 is based on the zone CAV and the disk layout is constructed by a lead-in zone 38, a defect management area 40, a user zone 48, a defect management area 42, a buffer zone 54 including a test track, a buffer zone 55, an inner control zone 56, and a buffer zone 58 from the outer side. Among them, a region in a range from the defect management area 40 on the outer side to the buffer zone 54 on the inner side relates to a data zone and the other regions correspond to a system zone. A first defect management area (DMA1) 44 and a second defect management area (DMA2) 46 are provided in the defect management area 40 on the outer side for the user zone 48. On the other hand, a third defect management area (DMA3) 50 and a fourth defect management area (DMA4) 52 are provided in the defect management area 42 on the inner side. As shown in a format of FIG. 5, a start position and an end position of each of the first defect management area 44, second defect management area 46, third defect management area 50, and fourth defect management area 52 have been determined. The same contents are recorded in each of the first to fourth defect management areas 44 to 52. Referring again to FIG. 4, as extracted and shown on the right side, the first defect management area 44 is made up of a disk definition structure (DDS) 62, a primary defect list (PDL) 64, and a secondary defect list (SDL) 66. Each of the remaining second defect management area 46, third defect management area 50, and fourth defect management area 52 also has contents similar to the contents of the first defect management area 44. Start addresses of the primary defect list 64 and secondary defect list 66 are stored in the disk definition structure 62 in accordance with a predetermined DDS format. Disk map data (DMD) regarding the data area and spare area in each zone of the user zone 48, which will be clearly described hereinlater has been also stored.

Detailed Description Text - DETX (14):

FIG. 10 is a functional block diagram of the optical storing apparatus of the invention for executing a slip process and an alternating process of a defective sector on the basis of the disk map data in FIG. 6. An optical disk drive 90 is connected to an upper apparatus (host) 88 through, for example, the SCSI interface. In the optical disk drive 90, functions of a command processing unit 92, a defect processing unit 94, and a medium accessing unit 96 are realized by a program control by the MPU 112 in FIGS. 9A and 9B. The command processing unit 92 receives commands from the upper apparatus 88 by the SCSI interface and executes the reading or writing operation after formatting the optical disk 36 enclosed in the optical disk cartridge 10. When a formatting command is received by the command processing unit 92 and a defective sector is detected during the execution of the formatting of the optical disk 36, the defect processing unit 94 registers a defect position address into the primary defect list 64 in the defect management area 44 developed in an RAM 98. The defect position address is defined by a logical track address and a sector address. When one address of the defective sector is registered into the primary defect list 64 as mentioned above, a slip process for using a next normal sector of the defective sector as an alternate sector is performed. Therefore, the data area 68 shown in FIG. 6 is arranged so that the last portion corresponding to only an amount of the defective sector enters the spare area 70. When a write command is received by the command processing unit 92 after completion of the formatting of the optical disk 36 and the defective sector is detected by the access of the designated sector of the write command, the position address of the defective sector is registered into the secondary defect list 66. The position address of the alternate sector in the spare area 70 serving as an alternation destination of the defective sector is also registered. Further, when the write command or read command is received by the command processing unit 92, the defect processing unit 94 first refers to the primary defect list 64 by the address of the receiving command. When it is recognized that the sector is the defective sector by referring to the primary defect list 64, a slip process for reading or writing from/to the first normal sector subsequent to the defective sector is executed. If the sector is not the defective sector with reference to the primary defect list 64 by the address of the read command or write command, the secondary defect list 66 is referred. When the defective sector is detected with reference to the secondary defect list 66, a position address of the alternate sector stored as a set together with the position address of the defective sector is obtained and the read access or write access for the alternate sector in the spare area is performed.

Detailed Description Text - DETX (15):

FIGS. 11A to 11C are explanatory diagrams of a defect process by the defect processing unit 94 in FIG. 10. FIG. 11A shows the data area 68 and spare area 70 of a certain zone. FIG. 11B shows the primary defect list 64. Further, FIG. 11C shows the secondary defect list 66. First, it is assumed that when a sector formatting of a head sector 100 having address A0 in FIG. 11A is performed by the formatting process, it cannot be formatted and it is recognized that this sector is a defective sector. By the detection of the defective sector 100 in association with the formatting, the defect processing unit 94 registers defect address A0 of the defective sector 100 into the primary defect list 64 in FIG. 11B. A final sector 104 in the data area 68 in FIG. 11A is slipped into the spare area 70 by only an amount of the defective sector 100 in response to the registration of defect address A0 to the primary defect list 64.

When the sector formatting is finished with respect to the data area 68, for example, as shown in FIG. 11B, defect addresses A0, A10, . . . , and Ai are stored. Now assuming that, for example, the head sector 100 in the data area 68 is subsequently accessed by a read/write command after completion of the formatting, the primary defect list 64 is referred by access address A0 at this time. When referring to the primary defect list 64, it will be understood that access address A0 has been registered as defect address A0 and the access sector 100 is the defective sector. In this case, therefore, the sector is slipped to a normal sector subsequent to next address A1 and the access is performed to this slip sector 102. Whether the slip sector 102 subsequent to the defective sector 100 is normal or not can be known by discriminating whether address A1 of slip sector 102 has been registered after defect address A0 in the Id primary defect list 64 or not. In this case, defect address A10 has been registered after defect address A0 and it will be understood that the sectors of addresses A1 to A9 are normal. It is now assumed that, for example, when sector address A50 in the data area 68 is accessed by the write command after completion of the formatting, it is found that sector address A50 indicates the defective sector. When it is detected that sector address A50 indicates the defective sector as mentioned above, defect address A10 is registered into the last space sector in the secondary defect list 66 as shown in FIG. 11C. Further, alternate address An in which the first space sector in the spare area 70 is set to the alternate sector is combined with defect address A50 and registered. That is, the position addresses of the defect source and the alternation destination are registered. With respect to the defective sector registered into the secondary defect list 66 after the formatting, at the time of access of address A50 by the read/write command, defect address A50 is recognized with reference to the secondary defect list 66 after referring to the primary defect list 64 and the access is performed to alternate address A0 which could simultaneously been obtained, namely, to the alternate sector in the spare area 70.

Detailed Description Text - DETX (16):

FIG. 12 is a flowchart for the medium formatting process in the optical disk drive 90 in FIG. 10. In the medium formatting process, in step S1, the sector formatting is started from the head of the data area 68. When the defective sector is detected in step S2, step S3 follows and the defect position address is registered into the primary defect list 64. The processes in steps S1 to S3 are repeated until the formatting of all of the zones is finished in step S4. The sector formatting of the spare area 70 is obviously executed subsequently to the data area 68 in FIG. 11A. As for the defective sector of the spare area 70, although the defect position address is registered to the primary defect list 64, the slip of the final sector of the spare area is not performed.

Detailed Description Text - DETX (17):

FIG. 13 is a flowchart for the alternate registering process by the defect processing unit 94 in FIG. 10. In the alternate registering process, when the defective sector is detected in step S1 due to the execution of the write command from the upper apparatus after the medium formatting process in FIG. 12 was finished, in step S2, the secondary defect list 66 in FIG. 11C is referred, the head space sector in the spare area 70 is retrieved from the last registered alternate address, and data is written by using the head space sector as an

alternate sector. In step S3, the defective address in the data area 68 and the alternate address in the spare area 70 in which the alternating process has been performed are registered into the secondary defect list 66.

Detailed Description Text - DETX (18):

FIGS. 14A and 14B are flowcharts for the accessing process including the read access or write access for the defective sector after completion of the registration to the primary defect list 64 in FIG. 11B or the secondary defect list 66 in FIG. 11C. First in step S1, on the basis of the disk map data 72 shown in FIG. 7, a head track address/sector address showing the head position of each zone is calculated and saved onto the table in the RAM. Subsequently in step S2, the apparatus waits for the input of a logical block address by the read command or write command from the upper apparatus. When the logical block address is inputted, step S3 follows and whether it belongs to the zone of zone No. n=0 or not is first discriminated. Specifically speaking, since the logical block address corresponding to each zone has been predetermined, by comparing the zone head logical block address with the input logical block address, whether the input logical block address belongs to the zone n or not can be recognized. When it does not belong to the zone n=0, the zone No. n is increased by "1" in step S4. A check is made to see if the logical block address belongs to the next zone No. n2. In a manner similar to the above, the processes in steps S3 and S4 are repeated until the zone No. n to which the logical block address belongs is recognized. When the zone No. n to which the input logical block address belongs is recognized, the sector address of the recognized zone n is calculated in step S4. The sector address of the zone n is calculated by

Detailed Description Text - DETX (20):

When the logical track address/sector address of the zone n can be calculated as mentioned above, in step S7, the primary defect list 64 is referred by the calculated logical track address/sector address. A check is made in step S8 to see if it is the defect address. When it is determined that the logical track address/sector address corresponding to the input logical block address is the defect address with reference to the primary defect list 64, the number of registered sectors on the primary defect list 64 in a range from the zone start track address/sector address to the inputted logical track address/sector address is retrieved in step S9. This process is equivalent to a process for obtaining the number of sectors which are necessary to slip of the defect address corresponding to the inputted logical track address/sector address.

Detailed Description Text - DETX (22):

In step S11, a check is made to see if the number of PDL sectors on the primary defect list 64 obtained in step S9 is the same as the retrieval number in the same previous logical track address/sector address. If YES, since the track address/sector address of the slip destination is correct, the processing routine advances to processes in step S12 and subsequent steps. If they do not coincide, since there is an error in the retrieval on the primary defect list 64 in step S9, the processes from step S9 are again repeated. When the processing routine advances to step S12 from step S11, the secondary defect list 66 is subsequently retrieved by the logical track address/sector address calculated in step S6. If the inputted logical track

address/sector address exists in the secondary defect list 66, it is recognized that the sector is the defective sector in step S13. In step S14, the logical track address/sector address of the alternation destination is obtained from the secondary defect list 66. Subsequently, in step S15, the reading or writing operation is executed to the decided input track address/sector address. In case of the normal sector which is not registered yet in each of the primary defect list 64 and secondary defect list 66, the track address/sector address to execute the reading or writing operation becomes the track address/sector address calculated in step S6. When the defective sector is recognized with reference to the secondary defect list 64, the track address/sector address of the slip destination calculated in step S10 is used. Further, when the defective sector is recognized by the retrieval of the secondary defect list 66, the track address/sector address of the alternation destination obtained in step S14 is used. When the reading or writing operation for the track address/sector address is executed in step S15, the presence or absence of an end instruction is discriminated in step S16. If there is no end instruction, the processing routine is again returned to step S2 and the apparatus waits for the input of the logical block address by the next read command or write command from the upper apparatus. When there is the end instruction in association with the log-off of the power source or the ejection of the medium in step S16, a series of processes is finished. When the end instruction is received, the primary defect list 64 and secondary defect list 66 developed in the RAM 98 in FIG. 10 are written back and preserved in the optical disk 36. After that, the power supply is turned off or the optical disk cartridge 10 is ejected. There is no need to write back the disk map data 72 included in the disk definition structure 62 since there is no change in contents.

Detailed Description Text - DETX (23):

FIG. 15 is an explanatory diagram in the case where a disk layout for the optical disk cartridge of 640 MB is used as a target of an optical recording medium according to the invention. In the optical disk of 640 MB, a control zone 260, a buffer zone 262, a buffer track 264, a defect management area 266, a user zone 272, a defect management area 274, a buffer track 220, and an outer test zone 222 are arranged from the inner side. The defect management area 266 on the inner side is constructed by a first defect management area (DMA1) 268 and a second defect management area (DMA2) 270. The defect management area 274 on the outer side is constructed by a third defect management area (DMA3) 276 and a fourth defect management area (DMA4) 278. The first defect management area 268, second defect management area 270, third defect management area 276, and fourth defect management area 278 have the same contents. For example, as extracted and shown on the right side with respect to the first defect management area 268, the area 268 is constructed by a disk definition structure 224, a primary defect list 226, and a secondary defect list 228. The user zone 272 is a rewritable zone which can be accessed by the SCSI interface with the upper apparatus and is divided into 11 zones from the inner side to the outer side as shown in FIG. 16. Zone Nos. 0 to 10 are allocated to the 11 zones. As shown on the right side with respect to zone No. 0, each zone is constructed by a data area 230 and a spare area 232. In the optical disk of 640 MB, the zone Nos. 0 to 10 are allocated from the inner side to the outer side and this order is opposite to the order in the case where the zone Nos. 01 to 17 are allocated from the outer side to the inner side of the optical disk of 1.3 GB in FIG. 6. That is, although the logical track numbers in the disk layout of the optical disk of

1.3 GB in FIG. 6 are increased toward the inner side while setting the outer side to the minus side, the optical disk of 640 MB in FIG. 16 has a reverse layout in which the logical track numbers are increased toward the outer side while setting the inner side to the minus side.

Detailed Description Paragraph Equation - DEEQ (3):

(track address/sector address)=(logical track address/sector address)+(the number of PDL sectors)

Current US Class - CLAS (1):

369

US-PAT-NO: 6631106

DOCUMENT-IDENTIFIER: US 6631106 B1

TITLE: Spare area with a predetermined capacity for a detective sector allocated in each zone

---

Detailed Description Text - DETX (23):

FIG. 15 is an explanatory diagram in the case where a disk layout for the optical disk cartridge of 640 MB is used as a target of an optical recording medium according to the invention. In the optical disk of 640 MB, a control zone 260, a buffer zone 262, a buffer track 264, a defect management area 266, a user zone 272, a defect management area 274, a buffer track 220, and an outer test zone 222 are arranged from the inner side. The defect management area 266 on the inner side is constructed by a first defect management area (DMA1) 268 and a second defect management area (DMA2) 270. The defect management area 274 on the outer side is constructed by a third defect management area (DMA3) 276 and a fourth defect management area (DMA4) 278. The first defect management area 268, second defect management area 270, third defect management area 276, and fourth defect management area 278 have the same contents. For example, as extracted and shown on the right side with respect to the first defect management area 268, the area 268 is constructed by a disk definition structure 224, a primary defect list 226, and a secondary defect list 228. The user zone 272 is a rewritable zone which can be accessed by the SCSI interface with the upper apparatus and is divided into 11 zones from the inner side to the outer side as shown in FIG. 16. Zone Nos. 0 to 10 are allocated to the 11 zones. As shown on the right side with respect to zone No. 0, each zone is constructed by a data area 230 and a spare area 232. In the optical disk of 640 MB, the zone Nos. 0 to 10 are allocated from the inner side to the outer side and this order is opposite to the order in the case where the zone Nos. 01 to 17 are allocated from the outer side to the inner side of the optical disk of 1.3 GB in FIG. 6. That is, although the logical track numbers in the disk layout of the optical disk of 1.3 GB in FIG. 6 are increased toward the inner side while setting the outer side to the minus side, the optical disk of 640 MB in FIG. 16 has a reverse layout in which the logical track numbers are increased toward the outer side while setting the inner side to the minus side.

Current US Class - CLAS (1):

369

Detailed Description Text - DETX (4):

An electronically programmable read only memory (EPROM) 7, a static random access memory (SRAM) 8, and a microprocessor 9 are connected to the ODC 2 by a processor bus 13. The EPROM 7 stores instructions to be made available to the microprocessor 9, for example, instructions for replacing a defective sector on the optical disk 11. The SRAM 8 stores work tables, for example a replacement list of defective sectors, and the PDL, SDL, and DDS from the optical disk 11. The microprocessor 9 steps through the instructions stored in the EPROM 7, controlling a mechanical drive device (not shown), instructing the ODC 2, the encoder/decoder 6 and the ABEP 5 to perform specific functions. Examples of the specific functions include, for example, write data to buffer from disk; write data to disk from buffer; transfer data from DRAM to SRAM (for reading the DDS, PDL and SDL); and transfer data from SRAM to DRAM (for updating the SDL or for formatting the medium and thus creating a DDS and PDL). The instructions for managing defects, as stored in the EPROM 7, and the tables, as stored in the SRAM 8, are covered in detail below.

Detailed Description Text - DETX (6):

FIG. 3 depicts a secondary defect list (SDL) 16 which identifies each secondary defective sector and its corresponding replacement sector. The secondary defects are found during use of the optical disk 11. Similar to the PDL 15, the standard provides for allocating sectors as replacements for secondary defects. Secondary defects are typically located when data is written to the optical disk 11 and read back for verification under stress conditions. If the ABEP 5 is unable to correct the errors, the sector responsible for the errors is flagged as being defective and its track and sector number is written to the SDL 16.

Detailed Description Text - DETX (10):

Defect management tables, which includes the PDL, SDL, and DDS are compiled and stored on the optical disk 11 according to the standard. When the optical disk 11 is inserted into the drive 1, or alternatively, if the drive 1 is powered on with the optical disk 11 installed, a initialization process will copy the defect management tables into the SRAM 8. Thereafter, each time a secondary defect is located, the SDL will be updated to reflect the addition. The SRAM 8 is likewise updated to reflect the additional secondary defect. Upon completing the reassignment process, a copy of the SDL 17 from the SRAM 8 is written back to the optical disk 11. On the other hand, the PDL 15 is written to the optical disk 11 only once during certification (or formatting). The replacement sector list 17, at initialization, is sorted and written to the SRAM 8. The replacement sector list 17 is a working list for providing information to the microprocessor 9 when spares are being located. The replacement sector list 17 may have a maximum size of 8 K bytes (2048 spare sectors * 4 bytes).

US-PAT-NO: 5235585

DOCUMENT-IDENTIFIER: US 5235585 A

****See image for Certificate of Correction****

TITLE: Reassigning defective sectors on a disk

US Patent No. - PN (1):

5235585

Brief Summary Text - BSTX (10):

An optical disk is an example of a storage medium having a very high storage density, and hence, requiring efficient defect management. A spiral track is formed on the surface of the disk from the center to the outer edge. The spiral track forms many separately identifiable tracks, and each track is further divided into a plurality of sectors. Alternatively, the tracks can be formed on the surface of the disk as a plurality of concentric circles. A predetermined number of sectors are identified as a group, there being one to many groups on the disk. The optical disk may have many defective sectors due to particles, contaminants, or other surface defects. A number of spare sectors are set aside on the disk, for example, a portion of the spare sectors are located at the end of each group, as replacements for defective sectors. Many defective sectors can be found by performing a surface analysis of the disk. During surface analysis, known data is written to a sector and read back under stress conditions. Surface analysis, if performed, may be accomplished by the disk manufacturer, or may be completed during the formatting process.

Brief Summary Text - BSTX (12):

A standard, ISO/IEC 10089:1991 (E) 130 mm Rewritable Optical Cartridge for Information Interchange, hereinafter referred to as the standard, has been established for 130 mm optical disk cartridges and is hereby incorporated by reference. The standard describes a method for recording defective sectors in the PDL and SDL. The standard also describes how to document the format of the media which is maintained in a disk definition structure (DDS). The DDS, for example, defines the number of groups (g), the number of sectors per group (m) set aside for data, and the number of spares per group (n). According to the standard, a user zone is made up of N+1 tracks (track 0 to N, wherein tracks 0, 1, 2, N-2, N-1 and N are reserved for use by the defect management areas (DMA). Therefore, N-5 tracks are available to a user. A maximum of 2048 sectors may be allocated as spares for the primary and secondary defect lists.

Detailed Description Text - DETX (4):

An electronically programmable read only memory (EPROM) 7, a static random access memory (SRAM) 8, and a microprocessor 9 are connected to the ODC 2 by a processor bus

13. The EPROM 7 stores instructions to be made available to the microprocessor 9, for example, instructions for replacing a defective sector on the optical disk 11. The SRAM 8 stores work tables, for example a replacement list of defective sectors, and the PDL, SDL, and DDS from the optical disk 11. The microprocessor 9 steps through the instructions stored in the EPROM 7, controlling a mechanical drive device (not shown), instructing the ODC 2, the encoder/decoder 6 and the ABEP 5 to perform specific functions. Examples of the specific functions include, for example, write data to buffer from disk; write data to disk from buffer; transfer data from DRAM to SRAM (for reading the DDS, PDL and SDL); and transfer data from SRAM to DRAM (for updating the SDL or for formatting the medium and thus creating a DDS and PDL). The instructions for managing defects, as stored in the EPROM 7, and the tables, as stored in the SRAM 8, are covered in detail below.

Detailed Description Text - DETX (5):

A primary defect list (PDL) 15, shown in FIG. 2, has the track and sector of each primary defect listed therein. The defective sectors listed in the PDL 15 are sectors that were determined to be defective during a surface analysis, for example, while formatting the optical disk 11. The surface analysis includes erasing the optical disk 11, writing data thereto, and reading the data back under stress conditions while looking for defective sectors. According to the ISO/IEC standard 10089:1991 (E), referred to hereinafter as the standard, up to 2048 defective sectors may be included in the PDL 15. Performing a surface analysis is not required, in which case the PDL 15 would be empty. However, since an optical disk inserted into the disk drive 1 may have had a surface analysis performed, the invention is described wherein there are entries in the PDL 15.

Detailed Description Text - DETX (10):

Defect management tables, which includes the PDL, SDL, and DDS are compiled and stored on the optical disk 11 according to the standard. When the optical disk 11 is inserted into the drive 1, or alternatively, if the drive 1 is powered on with the optical disk 11 installed, a initialization process will copy the defect management tables into the SRAM 8. Thereafter, each time a secondary defect is located, the SDL will be updated to reflect the addition. The SRAM 8 is likewise updated to reflect the additional secondary defect. Upon completing the reassignment process, a copy of the SDL 17 from the SRAM 8 is written back to the optical disk 11. On the other hand, the PDL 15 is written to the optical disk 11 only once during certification (or formatting). The replacement sector list 17, at initialization, is sorted and written to the SRAM 8. The replacement sector list 17 is a working list for providing information to the microprocessor 9 when spares are being located. The replacement sector list 17 may have a maximum size of 8 K bytes (2048 spare sectors * 4 bytes).

US-PAT-NO: 5235585

DOCUMENT-IDENTIFIER: US 5235585 A

****See image for Certificate of Correction****

TITLE: Reassigning defective sectors on a disk

US Patent No. - PN (1):

5235585

Detailed Description Text - DETX (23):

The find-spare routine is started at step 91. In step 95 the replacement sector list 17 is searched, for the highest track and sector entry less than or equal to the spare-area-end-pointer. This can be accomplished by using a binary search procedure with the spare-area-end-pointer as the list item to be searched. The binary search procedure can be designed to find a variable, wherein the variable is the largest list item less than or equal to the spare-area-end-pointer. A decision is made in step 97 to determine which spare is available to be used as a replacement sector. If no entry exists in the replacement sector list, or the entry points before the spare-area-start-pointer, the first spare within the spare area boundaries is identified as the replacement sector and is identified by a spare variable equal to the spare-area-start-pointer. If an entry is found, then it is already assigned as a replacement sector for a previously found secondary defect, and control is transferred to step 101 where that entry value is incremented such that the next higher spare is identified as a replacement sector. In the present example, track 19, sector 10 is identified as the spare.

Drawing Description Text - DRTX (3):

FIG. 2 is a primary defect list.

Drawing Description Text - DRTX (4):

FIG. 3 is a secondary defect list.

Detailed Description Text - DETX (4):

An electronically programmable read only memory (EPROM) 7, a static random access memory (SRAM) 8, and a microprocessor 9 are connected to the ODC 2 by a processor bus 13. The EPROM 7 stores instructions to be made available to the microprocessor 9, for example, instructions for replacing a defective sector on the optical disk 11. The SRAM 8 stores work tables, for example a replacement list of defective sectors, and the PDL, SDL, and DDS from the optical disk 11. The microprocessor 9 steps through the instructions stored in the EPROM 7, controlling a mechanical drive device (not shown), instructing the ODC 2, the encoder/decoder 6 and the ABEP 5 to perform specific functions. Examples of the specific functions include, for example, write data to buffer from disk; write data to disk from buffer; transfer data from DRAM to SRAM (for reading the DDS, PDL and SDL); and transfer data from SRAM to DRAM (for updating the SDL or for formatting the medium and thus creating a DDS and PDL). The instructions for managing defects, as stored in the EPROM 7, and the tables, as stored in the SRAM 8, are covered in detail below.

Detailed Description Text - DETX (5):

A primary defect list (PDL) 15, shown in FIG. 2, has the track and sector of each primary defect listed therein. The defective sectors listed in the PDL 15 are sectors that were determined to be defective during a surface analysis, for example, while formatting the optical disk 11. The surface analysis includes erasing the optical disk 11, writing data thereto, and reading the data back under stress conditions while looking for defective sectors. According to the ISO/IEC standard 10089:1991 (E), referred to hereinafter as the standard, up to 2048 defective sectors may be included in the PDL 15. Performing a surface analysis is not required, in which case the PDL 15 would be empty. However, since an optical disk inserted into the disk drive 1 may have had a surface analysis performed, the invention is described wherein there are entries in the PDL 15.

Detailed Description Text - DETX (6):

FIG. 3 depicts a secondary defect list (SDL) 16 which identifies each secondary defective sector and its corresponding replacement sector. The secondary defects are found during use of the optical disk 11. Similar to the PDL 15, the standard provides for allocating sectors as replacements for secondary defects. Secondary defects are typically located when data is written to the optical disk 11 and read back for verification under stress conditions. If the ABEP 5 is unable to correct the errors, the sector responsible for the errors is flagged as being defective and its track and sector number is written to the SDL 16.

Detailed Description Text - DETX (7):

FIG. 4 shows only the replacement sector list 17 which is a portion of the SDL 16. In the present invention, each time a replacement sector is added, the replacement sector list is updated so that the replacement sectors will be listed in ascending order according to track and sector numbers.

Detailed Description Text - DETX (9):

Two secondary defects are also depicted in the optical media map. Unlike the primary defects, the secondary defects do not cause slippage, but are instead replaced by the first available spare sector in the group zero. In this example, the secondary defect located at at track three, sector 5, is replaced by the spare sector located at track six, sector 11. If all ten spare sectors in a group have been used, then spare sectors from an adjoining or nearby group may be used. The primary and secondary defects, and the replacement sectors as depicted in the optical media map are tabulated in the PDL 15, SDL 16, and replacement sectors list 17, of FIGS. 2, 3, and 4, respectively.

Detailed Description Text - DETX (10):

Defect management tables, which includes the PDL, SDL, and DDS are compiled and stored on the optical disk 11 according to the standard. When the optical disk 11 is inserted into the drive 1, or alternatively, if the drive 1 is powered on with the optical disk 11 installed, a initialization process will copy the defect management tables into the SRAM 8. Thereafter, each time a secondary defect is located, the SDL will be updated to reflect the addition. The SRAM 8 is likewise updated to reflect the additional secondary defect. Upon completing the reassignment process, a copy of the SDL 17 from the SRAM 8 is written back to the optical disk 11. On the other hand, the PDL 15 is written to the optical disk 11 only once during certification (or formatting). The replacement sector list 17, at initialization, is sorted and written to the SRAM 8. The replacement sector list 17 is a working list for providing information to the microprocessor 9 when spares are being located. The replacement sector list 17 may have a maximum size of 8 K bytes (2048 spare sectors * 4 bytes).

Detailed Description Text - DETX (11):

FIGS. 6A-6C are flow diagrams setting fourth the steps for carrying out the present invention. The instructions represented by the flow diagrams, may for example, be instructions stored in the EPROM 7. The process begins at step 21 wherein a secondary defect has been identified and a request has been made for a replacement sector. In this example, it is assumed that track 18, sector 12 has been identified as being a secondary defect, and the primary and secondary defects are as listed in the PDL 15 and the SDL 16 and shown in the optical media map. At step 23 a decision is made as to whether this is the first request for a replacement sector. If this is the first request, the replacement sector list 17 is created in step 25, otherwise step 25 is bypassed and an already existing replacement list 17 is accessed for determining which spare sectors have been previously assigned At step 27 the microprocessor 9 calls a find-group routine to calculate a group number, g, for identifying which group the secondary defect is located within.

Detailed Description Text - DETX (12):

The find-group routine is shown in FIG. 7 and includes steps 47, 49, 51, and 53. The find-group routine is initiated at step 47. At step 49, the number of primary defects listed in the PDL 15 up to the identified secondary defect are counted and this number is set equal to a primary defect count variable The group, g, is then calculated in step 51 according to the following equation:

Detailed Description Text - DETX (13):

The result g is returned at step 53 wherein the process continues at step 29. In equation [3], the primary defect count, as determined from the primary defect list 15, adjusts for slippage that occurs due to primary defects. If a surface analysis is not done, the primary defect count will equal zero. Solving equation 3 yields:

Detailed Description Text - DETX (14):

Each group has 10 spares allocated for replacing secondary defects. To find a spare, the boundaries of the 10 spare sectors is first determined. Step 29 calls a find-spare-area-boundaries routine to determine the spare boundaries in group three. FIGS. 8A and 8B show the steps for determining the spare boundaries. The find-spare-area-boundaries routine begins at step 55, and at step 59 pointers A and B are initialized to point to the start of the PDL 15. In step 61, a track and sector value of a first spare in the group is determined by equation [4]:

Detailed Description Text - DETX (19):

The pointer B is then set to equal the location of the calculated track and calculated sector in the PDL 15 in step 63. Once again it is necessary to account for slippage due to the primary defects. An iteration process may be required and is continued until no further adjustments are necessary due to primary defects. Iteration may be required because the calculated track and the calculated sector determine where the spare boundary would be if there were no primary defects. A number of primary defects up to calculated track and the calculated sector are counted and added thus compensating for slippage. However, there may be additional primary defects located between the calculated track and sector and the location determined by adding the counted primary defects to the calculated track and sector. The number of primary defects is easily determined by making a count of the entries in the PDL 15 located between the pointer A and the Pointer B as done in step 65. If the count equals zero, as tested for in step 67, then there is no slippage, and a spare-area-start-pointer is set equal to the calculated track and the calculated sector in step 73. If there is no slippage it is not necessary to iterate since the calculated track and the calculate sector will not be moved ahead by a count wherein additional primary defects could be located.

US006631106B1

(12) **United States Patent**
Numata et al.

(10) **Patent No.: US 6,631,106 B1**
(45) **Date of Patent: Oct. 7, 2003**

(54) **SPARE AREA WITH A PREDETERMINED CAPACITY FOR A DETECTIVE SECTOR ALLOCATED IN EACH ZONE**

(75) Inventors: **Takehiko Numata**, Kawasaki (JP); **Mineo Moribe**, Kawasaki (JP); **Atsushi Takeuchi**, Miyagi (JP); **Teruo Chiba**, Miyagi (JP)

(73) Assignees: **Fujitsu Limited**, Kawasaki (JP); **Sony Corporation**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/246,638**

(22) Filed: **Feb. 8, 1999**

(30) **Foreign Application Priority Data**

Jul. 21, 1998 (JP) 10-205031

(51) **Int. Cl.**[7] **G11B 7/00**

(52) **U.S. Cl.** **369/53.17**; 369/44.33; 369/53.15; 369/30.07; 369/47.14

(58) **Field of Search** 369/30.07, 47.14, 369/53.41, 53.17, 53.24, 53.25, 53.13, 53.29, 13.44, 13.46, 53.15, 44.33, 275.3, 275.1, 30.13; 360/53, 72.2, 77.02; 711/201, 1, 4

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,111,444 A * 5/1992 Fukushima et al. 369/53.17
5,138,599 A * 8/1992 Fukushima et al. 369/30.13
5,235,585 A * 8/1993 Bish et al. 369/53.17
5,241,531 A * 8/1993 Ohno et al. 369/59.25
5,271,018 A 12/1993 Chan 371/10.2
5,319,627 A * 6/1994 Shinno et al. 369/53.17
5,345,435 A * 9/1994 Yamasaki 369/275.3
5,715,221 A * 2/1998 Ito et al. 369/47.14
5,717,662 A * 2/1998 Nishimura 369/13.44
5,848,438 A * 12/1998 Nemzzie et al. 711/201
6,175,549 B1 * 1/2001 Takagi et al. 369/53.15

FOREIGN PATENT DOCUMENTS

GB	2326015	12/1998
JP	54146617	11/1979
JP	62259267	11/1987
JP	6358671	3/1988
JP	63282967	11/1988
JP	02-156477	6/1990
JP	04-006670	1/1992
JP	453071	2/1992
JP	05-114247	5/1993
JP	7235139	9/1995
JP	8123626	5/1996
JP	08-124304	5/1996
JP	09-063137	3/1997
JP	9251721	9/1997

* cited by examiner

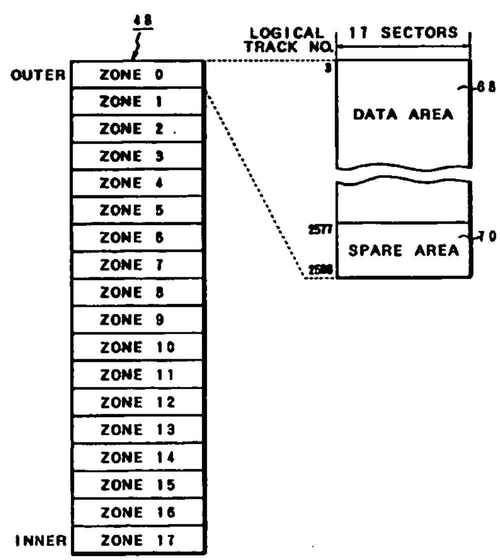
not sent

Primary Examiner—William Korzuch
Assistant Examiner—Kim-Kwok Chu
(74) *Attorney, Agent, or Firm*—Greer, Burns & Crain, Ltd.

(57) **ABSTRACT**

In a rewritable optical recording medium, a recording surface is divided into a plurality of zones by setting pitch intervals in the radial direction to be constant and a data area and a spare area for a defective sector are allocated in each zone. As for a capacity of the spare area in each zone, a predetermined total capacity of spare areas is allocated so that a spare ratio K=D1/D2 of a capacity D2 of the spare areas for a capacity D1 of the data areas becomes almost the same in the zones.

20 Claims, 20 Drawing Sheets



inbetween date